

EXECUTIVE SUMMARY

A. GOAL

The Common Sense Initiative-Computers and Electronics Sector sponsored a series of collection days to recover residential end-of-life (EOL) electrical and electronic equipment for demanufacturing and recycling. The goals of the pilot project were:

- to characterize the types and measure the volumes of end-of-life electrical and electronic equipment in the municipal waste stream
- to assess the economic viability of collecting, transporting, demanufacturing and recycling end-of-life (EOL) residential electrical and electronic equipment
- to gauge residential consumers willingness to help offset the costs of collecting and recycling electrical and electronic equipment

B. APPROACH

The collection pilots were held in two demographically similar communities: Somerville, Massachusetts and Binghamton, New York based on population, per capita income, state and local tax burden and weekly curbside pick-up of trash and recyclables. A total of four collection days were held, two events in the Fall of 1996 in both Somerville and Binghamton and two events in the Spring of 1997 in both communities.

The collection pilots were modeled after the traditional one-day collection events for household hazardous waste collection; typically, a one time collection event held on Saturday morning and early afternoon. Outreach for the events included direct mail flyers to every household, press release to local papers, signage at local retail establishments and advertising on local cable access channel calendars. A brief generator survey and receiving manifest were developed to record information from the collection events. Every participant was interviewed by a volunteer who recorded on a manifest what materials were dropped off. A survey was then given to a representative from each vehicle to assess their motivation for participating in the event, how they heard about the collection event, where they lived (in a single or multiple family home), the usage of the equipment (personal or business), the age and condition of the equipment, and the willingness to pay for this type of disposal.

Envirocycle, Incorporated, is an electronics demanufacturer who provided in kind services for the transportation, demanufacturing, recycling and disposal of all EOL equipment collected in the pilots. All EOL equipment that was collected was transported to Envirocycle's Hallstead, Pennsylvania facility. Envirocycle provided cost and revenue information for the transportation, demanufacture, marketing and disposal of all materials generated from the collection pilots.

C. PARTICIPATION RESULTS

Less than 1% of the residents in the host communities participated in the collection event. Generally, participation increased at both sites during the second event as was expected from past history of the communities other special collection events (i.e. household hazardous waste, tire and text book collection events). This increase of participation was also consistent with Somerville and Binghamton's experience with introducing new commodities as part of increasing recyclables collection.

Number of Households Participating vs. Number of Vehicles

	Households	% Participation by Household	Total # of Households
Somerville Fall 1996	193	0.62	31,000
Somerville Spring 1997	250	0.80	
Binghamton Fall 1996	47	0.02	25,000
Binghamton Spring 1997	128	0.05	

D. CHARACTERIZATION RESULTS

A total of 1,862 items of EOL was collected in the four collection events. The majority of the items collected consisted of TVs, computers and monitors, and portable audio equipment. These results were compiled from manifests that were completed by volunteers during the actual collection event.

	FALL 1996		Spring 1997		
	Somerville	Binghamton	Somerville	Binghamton	Total
HOME VIDEO					
Table Top TV	49	23	59	42	173
Floor Model TV	5	0	2	10	17
VCR	27	4	46	23	100
AUDIO					
Port. Radio/Tape/CD	58	1	36	82	177
Home Stereo	23	26	26	12	87
Tape Recorder	18	0	10	7	35
Car Audio/Tape	12	0	7	4	23
Speakers	23	3	17	6	49
Electronic Instruments	1	1	6	6	14
OFFICE					
PC/Computer	21	7	72	19	119
Monitor	17	8	52	33	110
Keyboard	18	7	44	26	95
Printer	12	2	40	9	63
Copier	0	0	1	0	1
Fax	0	0	1	1	2
COMMUNICATION					
Resident Phone	8	4	33	22	67
Business Phone	4	0	4	7	15
Cellular Phone	0	0	1	1	2
Cordless Phone	0	0	2	10	12
2-Way Radio	2	0	1	1	4
Answering Machine	4	4	31	8	47
HOME APPLIANCE					
Microwave Oven	12	3	12	12	39
Air Conditioner	8	0	19	8	35
Vacuum	17	2	7	18	54
SMALL COUNTER TOP APPLIANCE					
Toaster Oven	23	12	29	33	97
Can Opener	4	0	4	6	14
Coffee Maker	11	3	20	9	43
Food Processor	3	0	4	2	9
MISCELLANEOUS	10	35	213	101	
TOTAL	390	145	809	518	1862

A total of 32, 574 pounds of EOL equipment was collected in the four collection events.

Weight of Materials Collected

LOCATION	FALL 96	SPRING 97	% increase
Somerville	7,448 lbs.	13,723 lbs.	84%
Binghamton	2,372 lbs.	9,031 lbs.	281%

The largest category (by weight) of items collected was TVs, air conditioners and computer equipment. The EOL equipment collected was further divided into the

following categories for shipment to the demanufacturing facility.

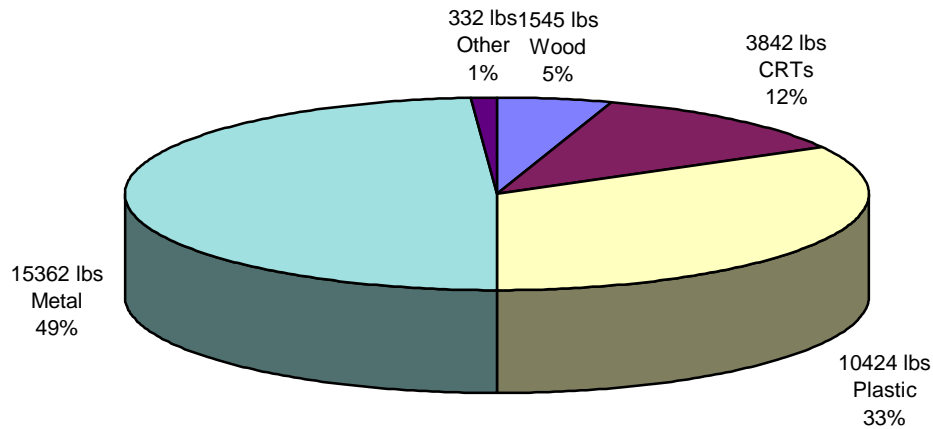
Collections by Weight in Pounds

CATEGORY	Somerville, MA		Binghamton, NY		TOTAL
	Fall 96	Spring 97	Fall 96	Spring 97	
Large TVs/ACs	1,665	3,508	893	2,932	8,998
Office Equipment	266	619	102	0	987
Large Electronics	1,196	762	205	878	3,041
Computer Equipment	852	3,529	339	1,487	6,207
Monitors/Small TVs	631	1,158	226	1,177	3,192
Small Electronics	738	584	134	761	2,217
Kitchen appliances	694	362	162	1,090	2,308
Miscellaneous	1,406	2,132	311	706	4,555
SUBTOTAL	7,448	12,654	2,372	9,031	31,505
Resale/Computer Equipment		1,069			
TOTAL	7,448	13,723	2,372	9,031	32,574

E. DEMANUFACTURING CHARACTERIZATION

The equipment collected was demanufactured and the following is a breakdown of the material fractions of the equipment. Metals (49%) and plastic (33%) combined account for over 82% of the collected materials. All materials were recycled and marketed with the exception of the wood which was disposed of in a municipal solid waste landfill.

Summary Of Raw Materials Demanufactured

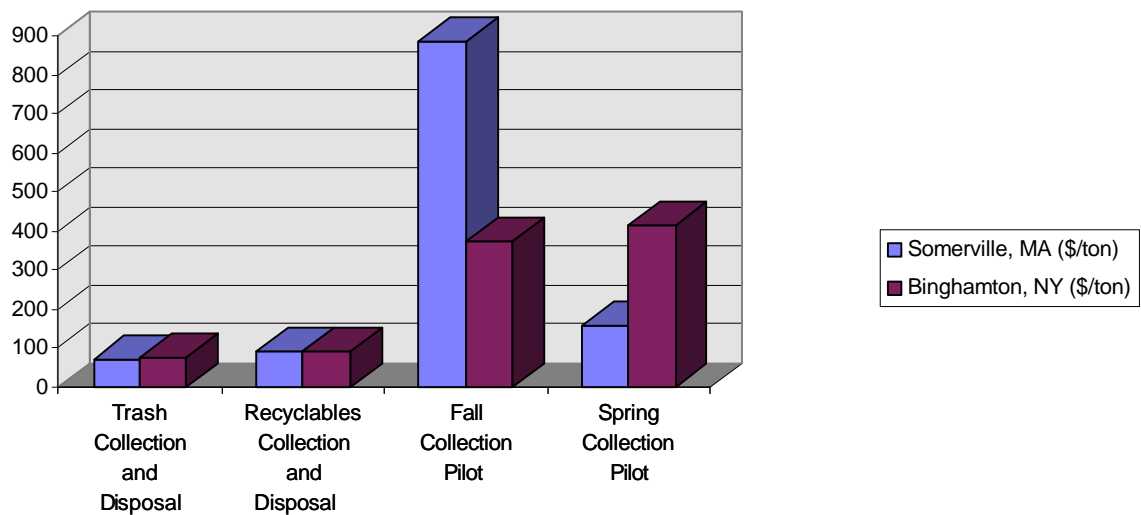


Total = 31,505 lbs

Note that a total of 1,069 pounds of computer equipment collected from the Spring 97 Somerville collection was not demanufactured but resold in the same condition it was collected.

F. CONCLUSIONS

This residential collection pilot project removed more than sixteen tons of material from municipal solid waste disposal, including some toxic constituents such as lead from CRT glass; and cadmium, and other potentially toxic substances as pigments, stabilizers or fire retardants in engineering plastics. The collections also captured alkaline and nickel-cadmium batteries.



The economic analysis from this **pilot** program to recover household electrical and electronic equipments from the municipal/small business waste stream ranged from \$159/ton to \$886/ton and thus exceeded the costs of handling those wastes as trash at \$75/ton or traditional recyclables at \$90/ton.

However, it is important to note that the costs provided in this report are based on pilot collection rates in a given area at a given time under specific marketing conditions. Historically, diverting any commodity from the municipal waste stream has not become economical until a recovery, reuse/recycle infrastructure has developed and matured for that commodity or group of commodities.

The general response from the residents was positive and consequently, both Binghamton and Somerville are including an end-of-life electrical and electronics collection in their 1998 solid waste program. Based on the lessons learned here, each community plans on modifying the collection model and strategy to collect, transport and demanufacture this material more efficiently. In addition, Envirocycle will be marketing this type of service to municipalities and is willing to work directly with municipalities to design and develop collection programs specific to a communities needs.

G. IMPROVING THE ECONOMICS

This pilot project was designed utilizing the one day collection event model typical for the collection of household hazardous waste. This pilot demonstrated that many variables impact the overall economics of the EOL electrical and electronic equipment collection. Based on the results of the pilot, and the traditional solid waste hierarchy of reduce, reuse, recycle, incinerate and finally landfill, several recommendations begin to emerge for improving the economics of end-of-life electrical and electronic collection and recovery programs including:

- **Efficient sorting of EOL electrical and electronic equipment** Based on the specific objectives of the collection event, segregate equipment for toxicity, existing recycling infrastructure (i.e. scrap metal), and value for demanufacturing or traditional disposal as municipal solid waste.
- **Evaluate partnering opportunities** There are existing organizations that can be accessed for charitable donation, and reuse or job training opportunities for working EOL electrical and electronic equipment.
- **Minimize transportation** Costs associated with transportation argue for minimizing distances from the collection site to the demanufacturing facility.
- **Maximize load** Costs associated with transportation argue that the maximum

safe load be trucked from the collection site to the demanufacturing facility.

- **Optimize the location and accessibility of the collection site** To encourage participation utilize an existing and known site(s) for collection activities within a community.
- **Minimize Collection Labor Costs** Utilize volunteer labor from existing municipal or recycling committees for the collection event.
- **Increase community participation** Organize outreach activities to maximize participation and to potentially tag onto other traditional community collection events, i.e. text book collections, household hazardous waste collections, tire collections.
- **Evaluate the communities willingness to pay** Based on accepted community practices and expectations, determine if a fee for the collection service is appropriate.

H. GENERAL RECOMMENDATIONS

The pilots conducted as part of this project followed on the traditional one day collection household hazardous waste model utilizing a electronics demanufacturer for reuse/resale, recycling and disposal. The results argue for improvements to the model to enhance the economic viability of conducting end-of-life electrical and electronic collections in municipalities. Every community is unique and should design a program that is applicable to its specific needs.

Given the small quantity captured in this pilot program, it is hypothesized that an on-going electrical and electronic equipment recycling program may have greater participation, and may yield a final cost equivalent to the current solid waste handling and disposal cost for a community. The economics may also be enhanced as the older electrical and electronic equipment is passed through the system and newer, more valuable electronic items may be recovered.

Note that there are other collection models that may be applied to end-of-life electrical and electronic equipment that were not specifically evaluated as part of this pilot. One collection method is partnering with local commercial business entities to organize a municipal collection event. A second collection method is partnering with existing not-for-profits to collect usable end-of-life electrical and electronic equipment. Finally, there are infinite collection, reuse, demanufacturing and recycling scenarios that may be applicable to a specific municipality. This report makes not attempt at evaluating every type of potential scenario. The CSI work group is sponsoring additional research into collection methodologies and will publish its findings in the Summer of 1998.